THE REGIONAL BORDER EFFECT IN SPAIN*

Luis LANASPA SANTOLARIA
Department of Economic Analysis, University of Zaragoza.
llanas@unizar.es

Irene OLLOQUI CUARTERO
Department of Economic Analysis, University of Zaragoza.

Fernando SANZ GRACIA
Department of Economic Analysis, University of Zaragoza.

Summary

This work is an empirical study of the Spanish Autonomous Communities from 2000 to 2010 to quantify the so-called border effect, or in other words, how much more intense are flows of goods between regions and the rest of Spain than between these regions and other countries. For this, we use the gravity equation model of trade. The main conclusions are: One, the border effect exists: the dummy variable which quantifies it is always positive and statistically different from zero. Two, the border effect tends to diminish over time. Three, estimating all the regions together, the border effect is around a factor of 10.5. Four, estimating each Autonomous Community independently, the greatest border effect is found in the Canary Islands (factor of 58.36) and the Balearic Islands (factor of 29.81); meanwhile, the regions with the least border effect are the ones with the two largest cities in the country: Catalonia (factor of 8.11) and Madrid (5.17), with Aragon in third place (8.14). Five, if we distinguish between regions' imports and exports, the border effect is significantly higher for the former (factor of nearly 17, compared to one of nearly 10).

Keywords: Border effect, Spanish Autonomous Communities, gravity equation
JEL classification: F14, R11

1. Introduction

It is no easy task to define the historical origins of the concept of the border, at least as we understand it today. Its birth is undoubtedly connected to the emergence of the first empires and their geographical expansion: from the first urban agglomerations where the Tigris and Euphrates come together, to the development of the Macedonian empire under Alexander the great, via ancient Egypt and classical Imperial China, which left the first physical expression of what is a border, the construction of the Great Wall. In this context, perhaps we can all agree that the first culture to make clear, from a functional viewpoint, what a border is or means, is ancient Rome. In the centuries of its expansion, everyone knew which territories were under the pax romana and which were not, who enjoyed the status of a roman citizen and who did not, all within a legally and linguistically unified framework. Jumping ahead more than a thousand years, the other historical event that defines the concept of the border in a way we can accept as definitive, it the birth of the nation in the current sense of the word, which occurs chronologically at the start of the Modern Age. These are no longer the shifting borders between kingdoms, duchies and other sovereign political entities of various kinds, all with a considerable degree of internal heterogeneity. They are borders between well-established countries, with their own differentiated language, culture, history and legal and institutional framework, which confer on them a certain unity, and within their frontiers their inhabitants are aware that they share different ideas and roots to those of their neighbours beyond their borders.

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At present, borders separate different nations whose languages, history, legislation, currencies, economic policies and idiosyncrasies are also different. In this sense, borders act as a dividing element, representing an obstacle to the transit of people, factors of production, goods and services. But borders can also be understood as a factor which unites and puts into contact more than it separates; this approach is especially important in the modern, globalised world, with its proliferation of political, economic and trade agreements between countries. Which element has more weight, one which brings together and communicates, or one which splits and divides? Certainly this is an important, and open, question; in any case, finding the right answer requires rigorous empirical exercises, designed ad hoc for this purpose. At the same time, the analysis can use different approaches. Here we will refer exclusively to the economic approach. And it is precisely in this context that the seminal contribution by McCallum (1995) appears, leading to the emergence in the literature of the so-called border effect, later to be the object of numerous quantifications, and which clearly defines the subject and the goal of this work. It would therefore be worth our while to go into some detail on what exactly McCallum (1995) did, and what the border effect actually is.

McCallum wanted to evaluate how permeable the frontier was between the USA and Canada, or in other words, whether it represented an obstacle to the transit of goods and services between the countries, and to what degree. To do this, he took the fourteen provinces of Canada and a similar number of US states (all those bordering Canada and the most important in terms of GDP). He considered two types of monetary flow: on one hand, exchanges between one Canadian province and another (interregional); on the other, exchanges between a Canadian province and a US state (international). Next, he investigated whether both types of flow were statistically different, and if so, which were more intense, and quantify these divergences (these are 20%, 50% or 200% more intense). For this task, it was not enough to compare the two series of data directly. It is essential to postulate a model of trade which controls for other variables, as well as the border effect, which evidently influence the size of the flows. To put it another way, the flow between two Canadian provinces, for example, could be very large and have nothing to do with a high border effect, but rather, be explained by these two provinces being very close to each other (which certainly favours exchanges) or having high incomes (high purchasing power and production capacity). McCallum, and all the later literature, chose a classic model of trade with excellent performance, in the sense that it describes the flows very well, with high values of the coefficient of determination (R2). We are talking about the famous gravity equation, which we study in the third part of this work.

It is now time to present the results deduced by McCallum. After controlling for the other variables affecting flows, such as the distance between areas, the seller's income, the buyer's income, the flows between Canadian provinces were nearly twenty times more intense, that is, 1900% more than their equivalents between Canadian provinces and US states! Yes, borders matter a great deal, and at least in the case of the one between the US and Canada, represent a considerable obstacle to exchanges. Interpreted in other terms, McCallum's result can also be understood to mean that the field of potential growth of international trade is still very large, in the sense that international flows can still increase a great deal before their magnitude becomes similar to interregional flows (which, obviously, do not count as international trade); to put it another way, globalisation is nowhere near its upper limit, given that international trade may experience very significant positive growth rates.

This conclusion, completely unexpected, especially in its magnitude, typified the so-called "border effect" in the literature, given that it is indeed relevant, as we have seen, and it generated a series of later works which we analyse briefly in the next section.

This is the context in which this work must be understood. It is intended to quantify the border effect for the Spanish Autonomous Communities or regions, that is, how different are the flows in both directions that each region maintains with the rest of the Spanish state, compared to its import and export flows with other countries. There are three main novelties in the exercise. First, a recently constructed database is used, which estimates inter-regional flows specifically and directly, something which is very hard to obtain and often simply approximated due to the lack of alternatives; as far as we know this is the first time that this database has been used to estimate the border effect in Spanish regions. Second, a relatively long recent period is considered, from 2000 to 2010, inclusive, enabling us to analyse the evolution over time of the magnitude of the border effect for each region. Finally, the degree of fit of the estimations made is very satisfactory, and the results relating to the quantification of the border effect are reasonable and largely corroborate those of other previous works, giving them robustness.

The main conclusions reached are: One, the border effect exists and is positive. Two, the border effect tends to diminish over time. Three, estimating all the regions together, the border effect is around a factor of 10.5. Four, estimating each region independently, the greatest border effect is found in the Canary Islands (factor of 58.36) and the Balearic Islands (29.81); meanwhile, the regions with the least border effect are Catalonia (8.11) and Madrid (5.17). Five, if we distinguish between imports and exports by the regions, the border effect is significantly higher for the former (factor of nearly 17, compared to one of nearly 10).

The rest of the work is articulated as follows. The second section is a selective review of the literature on the border effect. The third describes the methodology and the chosen model of trade, which is the gravity equation. The fourth section gives the details of the data used in this work, and their sources. The fifth section is the longest and describes the results of the empirical application. The next section is devoted to the conclusions, and finally, section seven closes the work with the bibliographic references.

2. The border effect: A brief review of the literature

This section is not exhaustive or highly detailed; we simply want to offer a brief selective review of the existing literature on the border effect, with a special emphasis on the Spanish case.

Helliwell (1998) is the first to return to the question after the pioneering article by McCallum (1995). Using the same data as the original work, he reviews the subject, trying to add econometric robustness to the original findings. He uses different specifications and approaches, but the result (the factor around twenty) is the same in all of them. In short, the work corroborates and gives solidity to the first unexpected conclusion.

The remaining works coincide in being based methodologically on the gravitational model. However, they differ in the geographical area studied. Feenstra (2002) again analyses the US-Canada border; Djankov and Freund (2002) use bilateral trade data between nine Russian regions and 14 former Soviet republics; Anderson and van Wincoop (2003) present a multilateral approach; Fukao and Okubo (2004) use data from Japan; Helble (2007) from France and Germany; finally, Head and Mayer (2010) study the case of the European union. As regards the qualitative and quantitative results reached, all these articles have one point of convergence: regardless of the different geographical areas analysed, they all conclude that the border effect exists.

For obvious reasons, we must refer particularly and in detail to the applications before this one which have considered the case of Spain or its regions as the geographical area for the empirical application. Minondo (2003) is the first to study a border effect which we could classify as regional, as he does not analyse the border between two countries, but rather quantifies how different the flows are between an Autonomous Community, in this case the Basque Country, and the rest of Spain, compared to the region's exchanges with other countries. Based on a rigorous standard use of the gravity equation, he deduces that from 1993 to 1999 the Basque Country had 20 to 26 times more trade with the rest of Spain than with other countries. Again using the gravitational model, Gil-Pareja et al. (2005) deduce that from 1995 to 1998 the Spanish regions traded with each other 21.8 times more than with other OECD countries; at the same time, in a clear forerunner of this work, they also estimate the border effect separately for each Autonomous Community ("region-specific gravity equations"), with their results oscillating between the lowest border effect in the Community of Madrid (factor in favour of the home bias of 8.5) and the largest, in the Balearic Islands (factor of 59.7).

3. The gravity equation and the border effect. Methodology

The gravity equation originates in work by economists from Finland (Pöyhönen, 1963, Pulliainen, 1963) and the Netherlands (Tinbergen, 1962). In fact, the merit of these authors is having been the first to use the gravity equation in the sphere of trade exchanges; gravitational models designed to explain migratory and tourism flows or phone calls between cities had already been applied (see Glejser and Dramais, 1969). The origin of the equation is far from strict deductive processes or rigorous theoretical reasoning, and in any case, the attempts to justify its existence from a theoretical point of view (Anderson, 1979; Bergstrand, 1985 and 1989) were made after it appeared. However, nobody doubts its excellent empirical performance and its great capacity for explaining flows of any kind between an emitter i and a receiver j. Its name draws an analogy between economics and physics, so that the size of the trade flow between region i and region j depends positively on their incomes (economic mass) and negatively on the distance between them:

$$M_{ij} = AY_i^{\upsilon 1} Y_j^{\upsilon 2} D_{ij}^{\upsilon 3} e^{u_{ij}} \qquad \textbf{(1)}$$

where M_{ij} is the current value of sales from i to j, A is the constant, Y is the current value of income, D is the distance between i and j, u_{ij} is noise and $\upsilon 1$, $\upsilon 2$ and $\upsilon 3$ are the elasticities to be estimated. Linnemann (1966) added the populations (L) of both areas as explanatory variables, leading to what we might call the basic formulation of the gravity equation for a given period of time:

$$M_{ij} = AY_i^{\upsilon 1} Y_j^{\upsilon 2} D_{ij}^{\upsilon 3} L_i^{\upsilon 4} L_j^{\upsilon 5} e^{u_{ij}} \quad \textbf{(2)}$$

Expression (2) constitutes a double-log functional form in incomes, populations and distance. Sanso et al. (1993) demonstrate, through the definition of Box-Cox (1964) transformations, that this functional form may not be the best from a statistical viewpoint, but it is, however, a good approximation to the best, which together with the simplicity of its application, leads us to adopt this functional form for this document.

Incomes have a positive influence, given that they represent the potential offer of exports in area i and the potential demand for imports in area j, and consequently their effect on M_{ij} is positive. The direction of the influence of populations is variable. Its elasticities can adopt both signs, and quite often not even be significant. Distance is a proxy variable of the natural resistance to trade and includes issues relating to transport costs and time, negatively affecting M_{ij}.

We have classified the specification given in (2) as basic, as nearly all authors include the five explanatory variables which appear there. Absolutely equivalent specifications to (2) are in terms of income and per capita incomes, or in terms of populations and per capita incomes, with a double-log functional form all three are interchangeable. However, without a theoretical framework which sets out exactly which variables can be included, the gravity equation lets researchers add as many as they want multiplicatively to (2) without any justification needed other than economic common sense. Thus, the following additional variables appear in the literature: surface area of the two countries, adherence to preferential trade agreements dummy, neighbouring countries dummy, shared language between countries dummy, preferential trade agreements dummy multiplied by distance, preferential trade agreements dummy multiplied by the product of per capita incomes of the countries, tariff protection indicators, other trade resistance measures, per capita factor endowments, price indices of the countries, price indices of the trade flows, exchange rates and their variability, and differences in per capita incomes among regions. Thus, regardless of the advisability of considering one variable or another, which will largely depend on the goal of one's research, the gravity equation is undeniably a highly flexible tool for explaining bilateral trade flows.

We have seen in the above paragraph that many of the variables which can be added to the so-called basic ones are dummies. In fact, the inclusion of a dummy in (2) will enable us to quantify the border effect, which is the question this essay is attempting to answer. This dummy, which we shall call Spain (SP hereafter) takes the value of one if the flow of one Autonomous Community, in both directions, is with the rest of Spain, and the value of zero if the flow corresponds to exports or imports between this Autonomous Community and another country outside Spain. Thus, expression (2) now appears as follows:

$$M_{ij} = AY_i^{\upsilon 1} Y_j^{\upsilon 2} D_{ij}^{\upsilon 3} L_i^{\upsilon 4} L_j^{\upsilon 5} e^{\upsilon 6 x SP} e^{u_{ij}} \quad \textbf{(3)}$$

when SP=1 (flow between an Autonomous Community and the rest of Spain), the equation (3) is:

$$M_{ij} = AY_i^{\upsilon 1} Y_j^{\upsilon 2} D_{ij}^{\upsilon 3} L_i^{\upsilon 4} L_j^{\upsilon 5} e^{\upsilon 6} e^{u_{ij}} \quad \textbf{(4)}$$

and when SP=0 (flow between an Autonomous Community and another country) the equation (3) is as follows:

$$M_{ij} = AY_i^{\upsilon 1} Y_j^{\upsilon 2} D_{ij}^{\upsilon 3} L_i^{\upsilon 4} L_j^{\upsilon 5} e^{u_{ij}} \quad \textbf{(5)}$$

so that the difference between both types of flow, expressions (4) and (5), is exactly $e^{\upsilon 6}$, which by definition represents the factor by which we must multiply the "normal" trade flow in (5) to change it to the "special" flow in (4) which it has with the rest of Spain. In short, the numerical value of $e^{\upsilon 6}$ defines, by construction, the magnitude of the border effect. And, fundamentally, all of this while discounting or controlling through the other variables affecting the flows (incomes, populations, distance, other dummies than SP), so that we can be reasonably sure that $e^{\upsilon 6}$ effectively gathers something that can be exclusively attributed to the border effect. Evidently, if υ6 is not statistically different to zero, $e^{\upsilon 6}=1$, there is no difference between both types of flow (the factor by which one type is multiplied to reach the other is one) and the border effect is null. At the same time, at least at the theoretical level, there is the possibility that υ6 is negative, in which case, $0< e^{\upsilon 6}<1$ and the most intense flows would be those between Autonomous Communities and other countries, not with the rest of Spain.

4. <u>The databases</u>

The goal of this work is to study the behaviour of the trade flows of Spanish Autonomous Communities or regions, and to quantify the so-called border effect in each of them for a relatively long recent period, such as the first decade of the 21st century, from 2000 to 2010 inclusive. The temporal horizon considered is the longest possible given the characteristics of the C-intereg database, which we will describe below.

The first step is to select the countries in the sample. In our case we decided to consider all the member states of the OECD (Germany, Australia, Austria, Belgium, Canada, Chile, South Korea, Denmark, Slovakia, Slovenia, the USA, Spain, Estonia, Finland, France, Greece, Hungary, Ireland, Iceland, Israel, Italy, Japan, Luxemburg, México, Norway, New Zealand, the Netherlands, Poland, Portugal, the UK, the Czech Republic, Sweden, Switzerland and Turkey), countries which are candidates to join it (Russia) and "enhanced engagement" countries (Brazil, China, India, Indonesia and South Africa). The trade flows of the Autonomous Communities with these forty countries represent on average 98% of all the trade flows of these Communities, leading us to assume that the sample of countries is sufficiently representative and will allow us to achieve our goal satisfactorily.

Now let's see the variables we need for this analysis. First, the endogenous variable, which is each Community's exports and imports to and from each of the 40 countries considered. This endogenous variable was obtained from two different sources. From C-intereg[†] we have taken the exports and imports of each Community to the other Communities, so that aggregating, we have the exports and imports of each Community with the rest of Spain. As far as we know, this is the first time this recently created database has been used for a study of the kind, which undoubtedly constitutes one of the contributions of this work.

[†] http://www.c-intereg.es. C-intereg is a project centred on the analysis of Spanish inter-regional trade, which began in 2004 as an initiative of the Centre for Economic Prediction, CEPREDE, sponsored by eight Autonomous Communities.

The second database used was Estacom[‡], from the ICEX (Institute of Foreign Trade), which is housed in the Ministry for the Economy and Competitiveness and uses data from the Tax Agency. This database enabled us to obtain the exports and imports between each Community and each of the countries considered except Spain.

The explanatory variables of the basic formulation of the gravity equation given in (2) and its sources are:

1. Gross Domestic Product (GDP) of the Autonomous Communities and the countries in the sample. Again, we used two different databases. The GDP of the Communities was obtained from the National Statistics Institute[§], INE, while for the GDP of countries, we used data provided by the World Bank[**]. When the country that the region's flow goes to and from is Spain, the Spanish GDP is calculated by subtracting the total for the region from the national total.

2. Population of the Autonomous Communities and the countries. The data sources are the same as for GDP. For the population of Spain, the same procedure was followed as for Spanish GDP.

3. Distance between the two areas involved in trade exchanges, i.e., the distance between an Autonomous Community and Spain, or between an Autonomous Community and each of the countries considered. The method for obtaining these distances is as follows.

The distance from Autonomous Community X to Spain is calculated in two phases. First we obtain the distance from each province of Community X to Spain, and in the second phase, the distance from Community X to Spain. First the distance is obtained[††], in a straight line, from the capital of each province of Community X to each Spanish provincial capital which is not in that Community. These distances are weighted by the population[‡‡] of each province in relation to the total population of Spain and added together, giving the distance from each province in Autonomous Community X to Spain. In the second phase we add together these provincial distances, now weighting them by the population represented by each province of Community X in relation to the total for Community X. This gives us the distance of each Spanish region from the rest of the Spanish state.

The distance from Autonomous Community X to a country Y was calculated in a similar way, also in two phases. First we obtain the distance (from the same source as before), in a straight line, from each province of Community X to the 5 largest cities in country Y. These distances are weighted by the weight of these cities[§§] and added together, giving the distance from each province of Autonomous Community X to country Y. In the second stage, we go from provincial distances to the distance from Community X to country Y in the same way as described above.

As the distance between each Autonomous Community and the rest of Spain or another country, calculated this way, vary very little from year to year, the distance variable is the same for the whole sample period. We used the populations of 2005, the central year of the range considered, for the weighting process described above.

5. <u>Results for Spanish Autonomous Communities</u>

The specification finally selected for the gravity equation is:

$$M_{ij} = AY_i^{\upsilon 1}Y_j^{\upsilon 2}D_{ij}^{\upsilon 3}L_i^{\upsilon 4}L_j^{\upsilon 5}e^{\upsilon 6xSP}e^{\upsilon 7xUE}e^{\upsilon 8xCOSTA}e^{u_{ij}} \qquad \textbf{(6)}$$

or, taking logarithms:

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‡ http://www.icex.es

§ http://www.ine.es

** http://www.bancomundial.org

†† http://es.lasdistancias.com

‡‡ http://www.ine.es

§§ http://unstats.un.org

$$\ln M_{ij} = \ln A + \upsilon 1 \ln Y_i + \upsilon 2 \ln Y_j + \upsilon 3 \ln D_{ij} + \upsilon 4 \ln L_i + \upsilon 5 \ln L_j + \upsilon 6 SP + \upsilon 7 UE + \upsilon 8 COSTA \quad (7)$$

where EU (European Union) is a dummy variable which takes value one if the flow of each Autonomous Community is with a member state of the European Union and zero if not; COAST is another dummy variable which takes value one if the flow of each Autonomous Community is with a country on the coast, and zero if not. Given the flexibility of the gravity equation, as mentioned in section three, we tried a whole range of alternative dummy variables, but they were systematically found not to be significant, and thus were not included in the final specification.

Meanwhile, SP is always significant and positive in all the estimations carried out, which are described below. The same cannot be said of EU and COAST, but as they are significant on a reasonable number of occasions, especially EU, they have been kept in the specification finally chosen.

5.1. Year by year estimation

As the sample size permits it (80 observations in each cross-section for each of the Autonomous Communities: 40 of exports and 40 of imports) we will begin by estimating the gravity equation, with the monetary variables expressed in the current terms of each period, year by year and for each region independently. In total, 187 regressions (17 Communities for 11 years) by heteroscedasticity-robust ordinary least squares. This option has notable advantages but also a few problems. Among the advantages, it provides a great deal of information and allows us to quantify the border effect for eleven different years, giving the option of analyzing its evolution over time, and for each region considered individually, enabling us to study the possibility of geographically differentiated behaviours. Its main disadvantage is that it is an estimation method which does not consider the complete information (all the years and all the areas) simultaneously, and thus does not expressly value the temporal and spatial dimensions of the data in the estimation. Fortunately, this lack is resolved in section 5.2 of this document.

First, we will present the results when we estimate the gravity equation year by year, but taking all the Autonomous Communities together in a single model (80x17=1360 observations). This information is offered in Tables 1 and 2; the former shows the estimation of the dummies SP, EU and COAST, and exp{SP}, exp{EU} and exp{COAST}, which quantify the border effect, the European Union effect (EU) and the COAST effect; the second shows the estimated elasticities of the remaining explanatory variables (incomes, populations and distance).

Table 1. OLS estimation year by year for all the Communities together. Border effect, EU effect and COAST effect

YEAR	SP	BORDER EFFECT	EU	EU EFFECT	COAST	COAST EFFECT	R^2 ADJ.
2000	2.42***	11.29	0.79***	2.21	0.39***	1.47	0.67
2001	2.44***	11.46	0.70***	2.01	0.31**	1.36	0.69
2002	2.35***	10.46	0.73***	2.08	0.20	-	0.67
2003	2.32***	10.17	0.68***	1.98	0.21	-	0.67
2004	2.33***	10.32	0.77***	2.16	0.44***	1.55	0.67
2005	2.45***	11.55	0.71***	2.03	0.37***	1.45	0.68
2006	2.37***	10.66	0.73***	2.07	0.33***	1.39	0.68
2007	2.34***	10.35	0.77***	2.17	0.36***	1.43	0.68
2008	2.32***	10.14	0.77***	2.16	0.30**	1.36	0.69
2009	2.41***	11.12	0.73***	2.07	0.21*	1.24	0.69
2010	2.34***	10.35	0.66***	1.94	0.14	-	0.68

* Significant at 10 % ** Significant at 5 % *** Significant at 1 %

Table 2. OLS estimation year by year for all the Communities together. Elasticities of the continuous explanatory variables

	Elasticity Y_i	Elasticity Y_j	Elasticity D_{ij}	Elasticity L_i	Elasticity L_j
2000	0.94***	1.21***	-1.09***	0.10	-0.24**
2001	0.85***	1.13***	-1.11***	0.17***	-0.18**
2002	0.80***	1.08***	-1.13***	0.23***	-0.10
2003	0.78***	1.01***	-1.15***	0.24***	-0.05
2004	0.76***	1.03***	-1.11***	0.30***	-0.05
2005	0.84***	1.06***	-1.07***	0.23***	-0.06
2006	0.77***	1.04***	-1.08***	0.29***	-0.05
2007	0.75***	1.01***	-1.07***	0.32***	0.00
2008	0.77***	0.96***	-1.06***	0.30***	0.06
2009	0.73***	0.96***	-1.09***	0.33***	0.09
2010	0.74***	0.89***	-1.09***	0.31***	0.17**

* Significant at 10 % ** Significant at 5 % *** Significant at 1 %

Some important conclusions can already be drawn from Table 1. First, that the border effect is fairly stable over time and a figure can be assigned to it, according to the year, of a factor ranging from 10 to 11.5; the same can be said of the EU effect, which can be quantified as a factor close to 2. It should be taken into account that Spain is also obviously considered to be a country in the European Union, so that the border effect already discounts the influence Spain might yield as an EU member. Both dummy variables, SP and EU, are also significant to 1% and the degree of fit (R2 adjusted) is more than acceptable, at nearly 70% of the explanatory power. The COAST effect only appears in eight of the eleven years; it is smaller than the EU effect, and can be quantified around 1.3-1.5.

In relation to Table 2, incomes, distance and the population of the seller (except for 2000) are always significant at 1%; we cannot say the same about the purchaser's population, which is significant only in 2000, 2001 and 2010, at 5% in all three years. The income elasticities of the importer are always somewhat higher than those of the exporter, and the value of both is not far from one, which is normal in the literature: a 1% increase in one of the two incomes leads to a similar percentage growth in the flow; at the same time, the two elasticities present a slight tendency to decrease over time. Distance elasticity is always negative and it is very stable over the years, quantifiable around -1.1: a reduction in distance (transport costs, trade barriers) of 1% increases bilateral flow by nearly 1.1%. The elasticity of the seller's population is somewhat lower than the other elasticities (around 0.25), although its size grows gradually in the decade considered.

Table 3 presents information relating to one of the basic goals of this work, the quantification of the border effect of each Autonomous Community and for each year. Although not shown in Table 3, the variable SP is significant at 1% for all years and regions.

Table 3. Border effect (BE) by Autonomous Community and year. R2 adjusted

		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	MEAN
Andalusia	e^{ESP}	14.92	13.21	14.10	12.81	11.78	11.03	11.45	12.91	12.51	17.35	15.33	13.40
	R^2_{ADJ}	0.78	0.81	0.79	0.80	0.79	0.74	0.74	0.77	0.77	0.77	0.78	0.78
Aragon	e^{ESP}	10.70	15.56	11.37	8.11	7.57	8.79	7.21	6.56	7.26	8.73	8.91	9.16
	R^2_{ADJ}	0.74	0.71	0.73	0.76	0.74	0.73	0.78	0.78	0.77	0.79	0.73	0.75
Asturias	e^{ESP}	19.07	26.06	18.13	21.68	21.23	22.43	20.58	17.07	22.16	20.28	14.17	20.26
	R^2_{ADJ}	0.72	0.73	0.72	0.70	0.65	0.69	0.65	0.71	0.65	0.65	0.71	0.69
Balearic Islands	e^{ESP}	43.91	37.93	24.48	23.24	19.77	35.64	42.52	42.45	29.14	24.01	32.11	32.29
	R^2_{ADJ}	0.65	0.59	0.67	0.54	0.61	0.63	0.58	0.53	0.62	0.61	0.67	0.61
Canary Islands	e^{ESP}	49.76	46.35	50.18	70.22	54.46	70.58	62.96	56.73	54.52	49.25	54.95	56.36
	R^2_{ADJ}	0.63	0.69	0.67	0.61	0.53	0.60	0.66	0.70	0.68	0.65	0.63	0.64
Cantabria	e^{ESP}	26.74	29.09	27.31	34.58	27.68	35.99	29.74	23.46	16.96	22.94	17.41	26.54
	R^2_{ADJ}	0.66	0.69	0.65	0.67	0.66	0.68	0.72	0.65	0.70	0.73	0.71	0.68
Castile and Leon	e^{ESP}	6.67	7.54	8.91	9.18	10.64	11.11	11.74	11.23	11.16	15.15	15.28	10.78
	R^2_{ADJ}	0.81	0.81	0.77	0.77	0.83	0.81	0.80	0.79	0.80	0.78	0.77	0.80
Castile–La Mancha	e^{ESP}	18.86	24.97	27.46	21.91	25.89	28.52	22.96	18.38	16.99	16.91	14.91	21.61
	R^2_{ADJ}	0.79	0.79	0.78	0.78	0.77	0.78	0.74	0.73	0.72	0.80	0.81	0.77
Catalonia	e^{ESP}	9.51	9.48	8.47	8.32	7.84	7.49	7.25	7.22	7.30	9.91	9.07	8.35
	R^2_{ADJ}	0.82	0.80	0.79	0.81	0.78	0.78	0.78	0.78	0.78	0.81	0.80	0.79
Valencian C.	e^{ESP}	11.76	11.19	9.95	9.35	9.05	10.43	9.56	8.79	9.24	8.94	8.64	9.72
	R^2_{ADJ}	0.82	0.82	0.81	0.82	0.84	0.83	0.82	0.83	0.82	0.84	0.85	0.83
Extremadura	e^{ESP}	49.50	41.17	41.68	27.76	34.76	30.95	21.05	28.46	21.36	18.97	22.24	30.72
	R^2_{ADJ}	0.65	0.69	0.62	0.67	0.66	0.72	0.71	0.63	0.69	0.57	0.62	0.66
Galicia	e^{ESP}	11.13	9.09	9.72	9.03	8.31	8.60	7.60	8.22	8.50	9.07	8.95	8.93
	R^2_{ADJ}	0.76	0.77	0.76	0.71	0.72	0.73	0.71	0.72	0.74	0.74	0.73	0.74
C. of Madrid	e^{ESP}	5.38	5.12	5.70	6.37	5.82	6.56	7.19	5.76	5.86	6.36	5.76	5.99
	R^2_{ADJ}	0.75	0.78	0.79	0.78	0.76	0.73	0.76	0.77	0.77	0.75	0.76	0.76
R. Murcia	e^{ESP}	21.65	16.45	16.61	13.27	16.53	15.60	16.27	11.68	11.65	13.78	13.53	15.18
	R^2_{ADJ}	0.76	0.76	0.78	0.80	0.80	0.78	0.74	0.68	0.70	0.68	0.55	0.73
Navarre	e^{ESP}	10.50	11.77	11.65	9.50	10.07	12.52	12.20	13.10	17.36	16.20	9.82	12.25
	R^2_{ADJ}	0.67	0.74	0.69	0.79	0.79	0.71	0.77	0.73	0.78	0.74	0.69	0.74
Basque Country	e^{ESP}	11.41	14.05	15.87	13.46	12.61	13.16	11.14	10.96	10.13	13.11	11.00	12.44
	R^2_{ADJ}	0.82	0.80	0.82	0.82	0.81	0.77	0.77	0.78	0.80	0.76	0.80	0.80
La Rioja	e^{ESP}	23.87	29.48	19.00	22.19	22.69	25.96	21.16	26.37	20.17	21.68	18.30	22.81
	R^2_{ADJ}	0.62	0.71	0.71	0.73	0.71	0.71	0.72	0.65	0.63	0.69	0.70	0.69
Average BE		20.32	20.50	18.86	18.88	18.04	20.90	18.98	18.20	16.60	17.21	16.49	
Average R^2_{ADJ}		0.73	0.75	0.74	0.74	0.73	0.73	0.73	0.72	0.73	0.73	0.72	

A number of important results can be extracted from Table 3. First, the goodness of fit is excellent: the adjusted coefficient of determination, according to years and regions, is around 0.75; it ranges between a minimum of 0.53 for the Canary Islands in 2004 and a maximum of 0.85 reached by the Valencian Community in 2010; this figure is reassuring, insofar as it demonstrates that the explanatory capacity of the gravity equation is high, and we can rely on the estimation of the border effect not being skewed by the omission of relevant variables. Second, the border effect differs widely among Autonomous Communities: the lowest in the Table is for the Community of Madrid in 2001 (5.12) and the highest in the Canary Islands in 2005 (70.58). If we look at the mean for the eleven years (last column of Table 3) we see that the greatest home bias appears in the island regions: the Canary Islands, and quite a lot lower, the Balearic Islands; possibly, their unique condition as islands makes them more dependent than other areas on transactions with the rest of the regions of Spain. In contrast, the

Communities with the lowest mean border effect are those with the two largest, most diversified and dynamic cities in the country, Barcelona and Madrid; their more cosmopolitan and heterogeneous nature means that the companies based there depend more on the exterior for their intermediate products, and at the same time, have a higher capacity and propensity for exporting.

There are two points to be made about these conclusions. One, they must be confirmed or refined by what is deduced in section 5.2, in which there is an estimation with panel data for each region, complementary to this one in section 5.1. Two, Table 1 shows that estimating all the Communities at the same time, the border effect, according to the year, is around 10-11; from Table 3 we deduce that the annual mean of the 17 border effects is noticeably higher, around 19. This is perfectly compatible because when finding the average in Table 3 each Autonomous Community enters with a weighting of one 17th, which does not occur in the estimation with all of them together, where the weight of each one is derived from its size and relative importance; remember that the Communities with the lowest border effect in Table 3, the Community of Madrid and Catalonia, are among the largest in the country, representing much more than (1/17) when estimated with all the areas at the same time, which undoubtedly results, as it does here, in a lower border effect in Table 1.

We will now analyse the evolution over time of the border effect: does it tend to increase or decrease? The penultimate row of Table 3 shows that on average, its magnitude in 2010 is lower than in 2000, indicating that the home bias decreases over time. Not surprisingly, the foreign sector has been the main support of our economy in these times of crisis, which appears to be corroborated by the reduction of dependence on domestic transactions which we can deduce from this row of the Table. But it is interesting to approach this question on a region by region basis, as their behaviours will not necessarily be the same. And in fact, they are not. Figures 1 to 6 represent the evolution of the border effect from 2000 to 2010 for the 17 Autonomous Communities, grouped in threes in the first five figures and in a pair in the last.

Figure 1. Evolution of the border effect from 2000 to 2010. Canary Islands, Balearic Islands and Extremadura

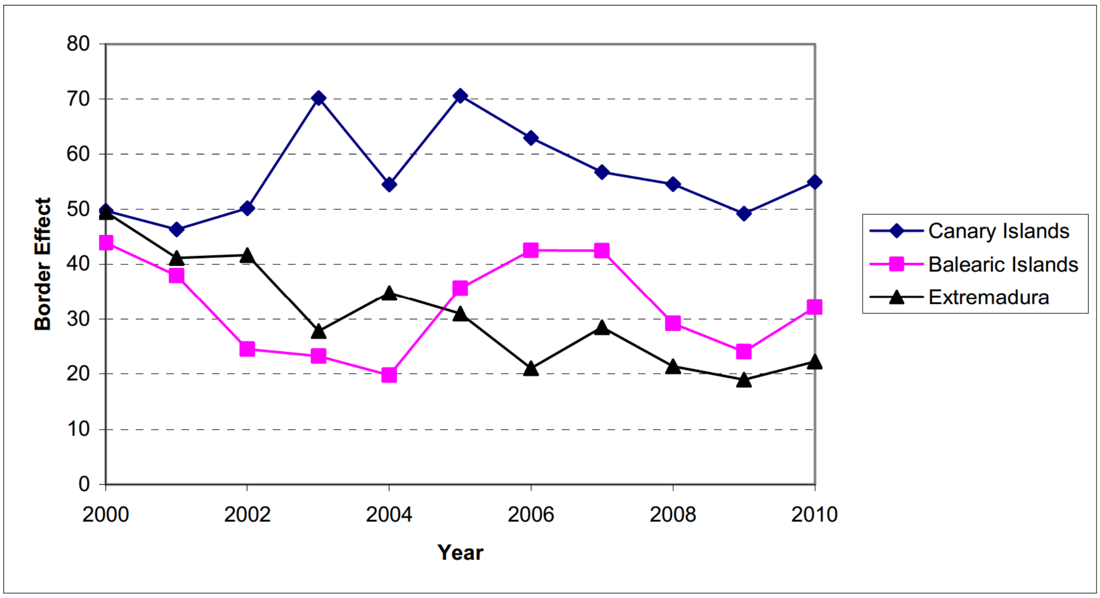


Figure 2. Evolution of the border effect from 2000 to 2010. Cantabria, La Rioja and Castile–La Mancha

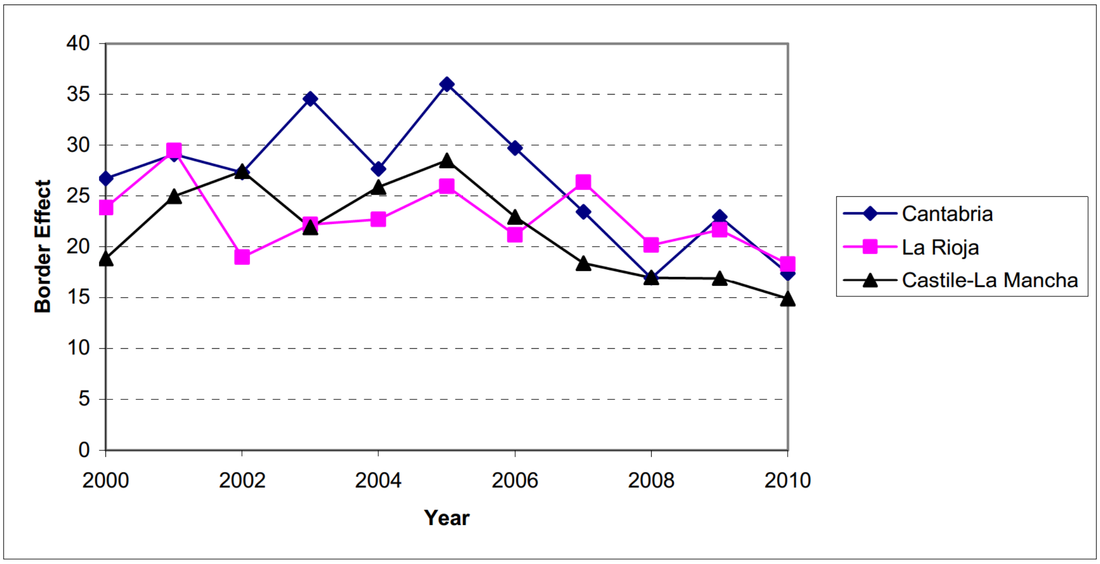


Figure 3. Evolution of the border effect from 2000 to 2010. Asturias, Region of Murcia and Andalusia

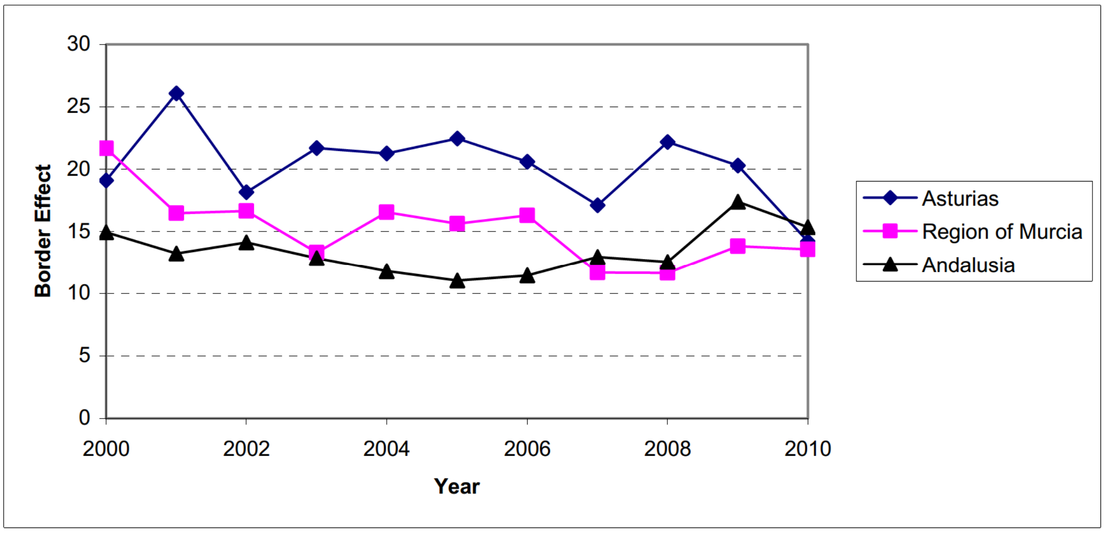


Figure 4. Evolution of the border effect from 2000 to 2010. Basque Country, Navarre and Castile and León

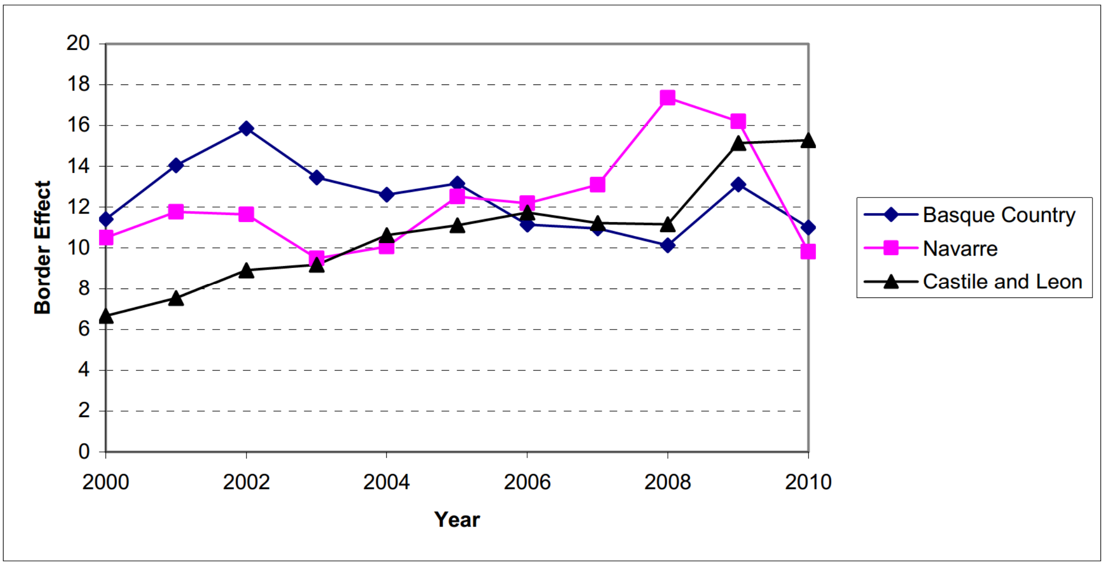


Figure 5. Evolution of the border effect from 2000 to 2010. Valencian Community, Aragon and Galicia

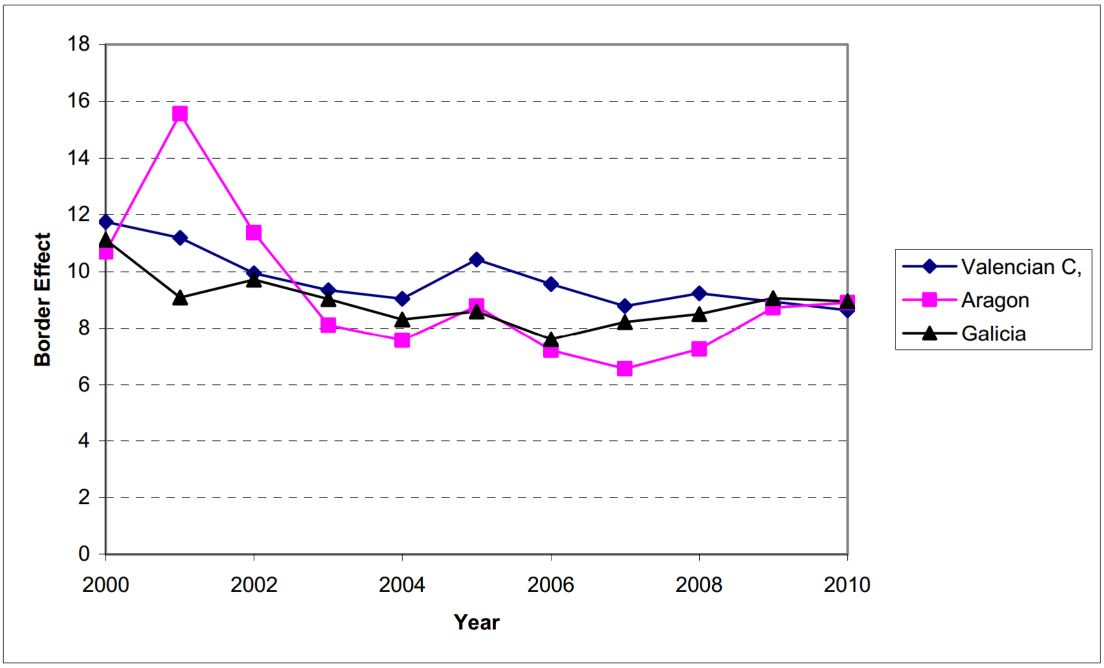
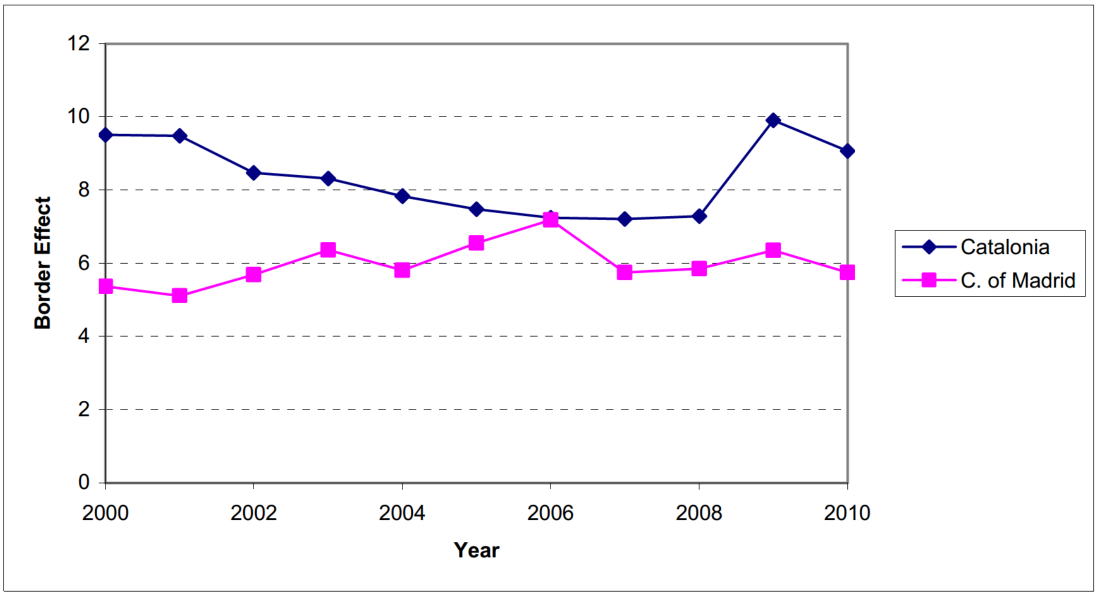


Figure 6. Evolution of the border effect from 2000 to 2010. Catalonia and the Community of Madrid



The predominant behaviour, with peaks and different intensities, is that the border effect tends to decrease over time. This happens in Extremadura, Cantabria, Castile–La Mancha, Asturias, Region of Murcia, Valencian Community and Aragon; it also decreases, albeit less so, in La Rioja, the Basque Country and Galicia. In five regions no trend of any kind is seen, so we cannot point to decrease or increase: the Canary Islands, the Balearic Islands, Andalusia, Catalonia and the Community of Madrid. Finally, Navarre evolves upwards, although it dips considerably in the last two years, and Castile and León go against the rule, with the magnitude of their home bias increasing steadily from 2000 to 2010.

5.2. Joint estimation

This section tries to exploit fully the temporal and spatial links and interrelations of our data pool. We have two alternatives for this: a panel estimation with fixed effects or a panel estimation with random effects. The Hausman test (1978) is used to determine which method is preferable. A key problem of the fixed effects estimator, given the characteristics and goal of this work, is that it is not compatible with the existence of time-invariant variables, such as our essential SP. Therefore, when the random effects procedure is not recommended by the Hausman test, we will use the SURE method (seemingly unrelated regressions). Both scenarios, i.e., the random effects panel and SURE, include temporal annual dummies.

Table 4 shows the joint estimation for the whole sample (11 years x 17 areas x 80 flows in both directions = 14960 observations). The first numerical column shows the results of the random effects panel estimator. The Hausman test accepts the null hypothesis that the random effects estimators are consistent, and therefore valid; however, despite this, and to give robustness, an alternative method is presented, the SURE in the second column.

Table 4. Estimations with the entire data pool. Random effects panel (RE PANEL) and SURE

	RE PANEL	SURE
SP	2.35***	2.37***
Border effect	10.44	10.72
Elasticity Y_i	0.96***	0.80***
Elasticity Y_j	0.98***	1.03***
Elasticity D_{ij}	-1.17***	-1.10***
Elasticity L_i	0.09**	0.25***
Elasticity L_j	0.00	-0.03
EU	0.46***	0.73***
EU effect	1.58	2.07
Coast	0.32***	0.30***
Coast effect	1.38	1.35
R^2 ADJ.	0.68	0.68
Hausman	24.53 (0.06)	

* Significant at 10 %   ** Significant at 5 %   *** Significant at 1 %

Both methods, random effects and SURE offer similar results, which is certainly reassuring and makes the results more robust and reliable. All the variables are significant and have the expected sign, except the purchaser population, which is not statistically different to zero. The magnitude of the border effect is around 10.5, very similar to that deduced from Table 1 year by year. At the same time, the EU effect and the COAST effect also present figures close to what appears in Table 1: 1.5 to 2 for the EU effect, according to the estimation method (random effects or SURE) and 1.35 to 1.38 for the COAST effect.

Table 5 shows the estimation by random effects and SURE of specific panels for each Autonomous Community, i.e., the sample size in each of the 17 rows is 880 (80 flows by 11 years).

Table 5. Random effects panel and SURE for each Autonomous Community. Border effect

	RANDOM EFFECTS PANEL ESTIMATION				SURE ESTIMATION		
	COEF SP	BORDER EFFECT	HAUSMAN TEST	R^2 ADJ.	COEF SP	BORDER EFFECT	R^2 ADJ.
Andalusia	2.61***	13.62	0.83 (0.99)	0.79	2.60***	13.45	0.79
Aragon	2.10***	8.14	9.20 (0.87)	0.75	2.18***	8.85	0.76
Asturias	2.98***	19.73	2.33 (0.99)	0.71	3.01***	20.21	0.71
Balearic Islands	3.39***	29.81	4.19 (0.99)	0.61	3.45***	31.48	0.62
Canary Islands	4.07***	58.36	28.56 (0.02)	0.60	4.03***	56.12	0.65
Cantabria	3.18***	24.02	4.01 (0.99)	0.70	3.25***	25.73	0.70
Castile and Leon	2.21***	9.15	4.69 (0.99)	0.80	2.32***	10.13	0.80
Castile–La Mancha	2.98***	19.77	9.95 (0.82)	0.78	3.05***	21.19	0.78
Catalonia	2.09***	8.11	7.29 (0.95)	0.80	2.12***	8.34	0.81
Valencian C.	2.23***	9.28	26.66 (0.03)	0.82	2.27***	9.65	0.84
Extremadura	3.31***	27.43	4.78 (0.99)	0.67	3.38***	29.31	0.67
Galicia	2.27***	9.71	9.23 (0.87)	0.73	2.21***	9.09	0.75
C. of Madrid	1.64**	5.17	5.99 (0.98)	0.77	1.77***	5.88	0.78
Region of Murcia	2.52***	12.46	8.00 (0.92)	0.71	2.67***	14.43	0.72
Navarre	2.40***	11.00	6.40 (0.97)	0.73	2.48***	12.00	0.74
Basque Country	2.48***	11.97	5.25 (0.99)	0.79	2.52***	12.42	0.81
La Rioja	3.11***	22.41	1.22 (0.99)	0.70	3.15***	23.32	0.71

* Significant at 10 % ** Significant at 5 % *** Significant at 1 %

The Hausman test indicates that the estimators of the positional parameters are consistent under the random effects panel specification (as opposed to that of fixed effects). We only reject this specification at 5% for the Canary Islands and the Valencian Community; because of this, we opted to also estimate the model using seemingly unrelated regressions, including a different constant for each period and imposing an equality restriction on the rest of the exogenous variables of the model for all years.

As for quantifying the border effect, both methods offer very similar figures. They are also very similar to those of the last column of Table 3, which showed the average border effect of the eleven years for each area, simply estimated by heteroscedasticity-robust ordinary least squares. It is very important to stress that the order of the Autonomous Communities deduced from the last column of Table 3 and derived from the second numerical column of Table 5 is practically the same. Effectively, the regions with the greatest border effect are still the islands (Canaries with 58.36 and Balearics with 29.81); at the other extreme, the lowest border effect is still found in the Community of Madrid (5.17), followed by Catalonia (8.11) and Aragon (8.14). Consequently, we can be reasonably sure that the magnitudes of the border effect for each region are being estimated correctly, as different methods lead to very similar estimations of the effect. Moreover, so if we compare the order of the regions according to the border effect found in Table 5 and that found in Table 3 of the Gil-Pareja et al. (2005) article, we conclude that the Spearman’s rank correlation coefficient is 0.78, statistically different from zero and close to one. In short, the two orders referred to are similar, indicating the robustness of the results shown here.

Table 6. Elasticities of the continuous explanatory variables Random effects panel, except the Canary Islands and Valencian Community with SURE

	Elasticity Y_i	Elasticity Y_j	Elasticity D_{ij}	Elasticity L_i	Elasticity L_j
Andalusia	0.66***	0.90***	-0.84***	0.24**	-0.06
Aragon	0.65***	0.55***	-1.42***	0.22*	0.28**
Asturias	1.11***	0.76***	-0.99***	-0.02	0.15
Balearic Islands	0.79***	1.24***	-0.81***	0.24	-0.38**
Canary Islands	1.08***	1.22***	-1.28***	0.34	-0.73**
Cantabria	0.92***	0.58***	-0.69***	-0.01	0.28*
Castile and Leon	0.47***	0.52***	-1.47***	0.32***	0.34**
Castile–La Mancha	0.72***	1.00***	-1.11***	0.32**	-0.05
Catalonia	0.72***	0.72***	-0.80***	0.11	0.01
Valencian C.	0.38**	0.64***	-0.35***	0.48***	0.13
Extremadura	0.37*	1.11***	-1.40***	0.60***	-0.05
Galicia	0.68***	0.70***	-0.95***	0.10	-0.06
C. of Madrid	0.87***	0.76***	-0.99***	0.19*	-0.01
Region of Murcia	0.64***	0.88***	-1.10***	0.35**	0.10
Navarre	0.87***	0.77***	-1.24***	-0.04	0.16
Basque Country	0.67***	0.61***	-0.98***	0.06	0.13
La Rioja	0.49***	0.92***	-1.21***	0.23	-0.02

* Significant at 10 %   ** Significant at 5 %   *** Significant at 1 %

Once again, the magnitude and sign of the elasticities shown in Table 6 agree with the previous literature. Incomes are practically always significant at 1% and do not tend to be far from one. Distance elasticity, according to areas, is around -1. Finally, as we already know from previous results, populations are significant in notably fewer cases.

Table 7. EU and COAST effects. Random effects panel, except the Canary Islands and Valencian Community with SURE

	EU	EU EFFECT	COAST	COAST EFFECT
Andalusia	0.54***	1.71	0.90***	2.47
Aragon	0.36***	1.44	0.01	-
Asturias	0.41***	1.50	0.63	-
Balearic Islands	0.73***	2.08	0.46	-
Canary Islands	0.57	-	1.18*	3.25
Cantabria	0.93***	2.54	0.70**	2.01
Castile and Leon	0.54***	1.71	0.36	-
Castile–La Mancha	1.12***	3.07	-0.30	-
Catalonia	0.34***	1.40	-0.01	-
Valencian C.	0.66***	1.94	0.58*	1.79
Extremadura	0.89***	2.44	0.75*	2.12
Galicia	0.72***	2.06	1.27***	3.55
C. of Madrid	0.27***	1.32	-0.24	-
Region of Murcia	0.23*	1.26	0.40	-
Navarre	0.18	-	-0.38	-
Basque Country	0.03	-	0.52**	1.69
La Rioja	0.81***	2.25	0.49	-

* Significant at 10 %   ** Significant at 5 %   *** Significant at 1 %

The dummy variable EU is significant, and therefore gives an EU effect in fourteen of the seventeen Spanish regions. The factor by which trade with EU countries is multiplied compared to trade with non-EU countries ranges from 1.26 in the Region of Murcia (as EU is significant only at 10%) to 3.07 in Castile-La Mancha. As for the COAST effect, this is much less frequent and appears only in Andalusia, Canary Islands, Cantabria, Valencian Community, Galicia, Basque Country and Extremadura, this last being the only Community of this group without access to the sea. Its magnitude ranges from a factor of 1.69 for the Basque Country to a maximum of 3.55 for Galicia.

Once the joint estimation has been analysed in detail, either with a random effects panel or a SURE, for all the regions together and each one individually, it makes sense for us to wonder if the magnitude of the border effect is the same or not, depending on whether we are talking about the exports or the imports of each Autonomous Community. Table 8 offers some preliminary answers to this question. There are 7480 observations (11 years x 17 Communities x 40 flows). The Hausman test indicates that the positional parameter estimators are not consistent under the specification of the random effects panel for exports, so we also offer the SURE method estimation in the two columns to the right.

Table 8. Random effects panel and SURE estimators. Exports and imports separately

	RE PANEL		SURE	
	EXPORTS	IMPORTS	EXPORTS	IMPORTS
SP	2.30***	2.83***	2.34***	2.87***
Border effect	9.97	16.95	10.33	17.61
EU	0.36***	0.57***	0.49***	0.95***
EU effect	1.43	1.77	1.63	2.58
COAST	0.68***	0.27**	0.66***	0.24*
COAST EFFECT	1.97	1.31	1.93	1.27
Elasticity Y_i	2.26***	0.75***	2.58***	0.67***
Elasticity Y_j	0.74***	2.89***	0.75***	2.95***
Elasticity D_{ij}	-1.33***	-0.97***	-1.28***	-0.86***
Elasticity L_i	-1.09***	0.20***	-1.40***	0.29***
Elasticity L_j	0.07*	-1.41***	0.07***	-1.47***
HAUSMAN TEST	28.50 (0.02)	19.28 (0.20)		
R^2 ADJ	0.70	0.74	0.70	0.74

* Significant at 10 % ** Significant at 5 % *** Significant at 1 %

We draw a series of interesting conclusions from Table 8. First, and this result is highly relevant, home bias is more intense in imports. In other words, dependence on national flows for all our regions is stronger in their respective purchases. The EU effect is also more intense in imports, while for the COAST effect the opposite happens. Regarding elasticities, the fact that only sales or only purchases are estimated introduces some special characteristics in how variables are incorporated in the gravity equation that leads to more extreme estimators, even changing sign in the case of populations when we talk about exports or imports.

We can repeat the exercise, i.e., differentiate between sales and purchases, but for each Autonomous Community in particular. This information is presented in Table 9. Each estimation has 440 observations (11 years x 40 flows). Only the border effect is shown for each region, and the corrected coefficient of determination. From the Hausman test, which is not given in this Table, we deduce that the random effects estimation is the right one.

Table 9. Exports and imports separately for each region. Random effects only

	EXPORTS		IMPORTS	
	BORDER EFFECT	R^2 ADJ.	BORDER EFFECT	R^2 ADJ.
Andalusia	9.52	0.84	19.66	0.77
Aragon	10.22	0.75	6.28	0.80
Asturias	13.13	0.79	30.07	0.66
Balearic Islands	17.71	0.61	49.52	0.61
Canary Islands	62.87	0.67	52.33	0.74
Cantabria	17.89	0.75	32.70	0.70
Castile and Leon	9.14	0.78	9.35	0.84
Castile–La Mancha	24.19	0.84	16.34	0.78
Catalonia	11.36	0.81	5.85	0.81
Valencian C.	5.93	0.84	14.56	0.85
Extremadura	16.77	0.71	45.83	0.65
Galicia	6.90	0.81	13.64	0.70
C. of Madrid	12.80	0.78	2.11	0.85
Region of Murcia	9.68	0.87	15.94	0.68
Navarre	8.58	0.80	14.02	0.70
Basque Country	11.41	0.82	12.45	0.79
La Rioja	13.87	0.80	35.89	0.65

It can be confirmed that the joint border effect (Table 5) is always in the middle of the border effect which distinguishes between purchases and sales (Table 9), which is perfectly reasonable. Meanwhile, the border effect in imports is larger than in exports in a majority of Autonomous Communities, in as many as twelve, as would be expected in the light of what we deduced from Table 8. The only regions where the home bias is higher in exports are Aragon, the Canary Islands, Castile-La Mancha, Catalonia, and the Community of Madrid. Finally, there are Autonomous Communities where the differences between border effects for purchases or sales are not appreciable; this is the case for Castile and Leon and the Basque Country. In contrast, for others the divergences are spectacular; in this group we can include the Balearic Islands, the Valencian Community, Extremadura, La Rioja, and above all, the Community of Madrid, which has a home bias for imports of 2.11 and for exports of 12.80, six times greater.

6. Conclusions

The border effect appears in the literature after the seminal work of McCallum (1995). Briefly, it concludes that after controlling for other variables which affect exchanges, the flows between Canadian provinces are twenty times higher than flows between a Canadian province and an American state. At first glance, few people would think the border between these two nations could represent such an obstacle to international transactions.

This is the context of the document presented here. Thus, it revisits the border effect, quantifying its magnitude for the 17 Autonomous Communities of Spain from 2000 to 2010. In brief, it attempts to answer this question: Are the flows between Spanish regions and the rest of Spain different to the flows between these regions and 40 other countries? And if so, what is the multiplying factor? To do this, it takes the specified gravity equation model of trade, in a standard form, in its double-logarithmic version and with incomes, populations and distances as continuous explanatory variables, to which it adds three dummy variables: the first one enables us to quantify the border effect precisely; the second discriminates between flows of Spanish regions with European Union countries and with non-EU countries, and the third differentiates whether the flow is with a country with a coast or with one with no access to the sea.

There are three main novelties in the exercise. First, a recently constructed database is used, which estimates inter-regional flows specifically and directly, something which is very hard to obtain and often simply approximated due to the lack of alternatives; as far as we know this is the first time that this database has been used to estimate the border effect in Spanish regions. Second, a relatively long recent period is considered, from 2000 to 2010, inclusive, enabling us to analyse the evolution over time of the magnitude of the border effect for each region. Finally, the fit of the estimations is very satisfactory, and the results for the quantification of the border effect are robust for different estimation methods (year by year heteroscedasticity-corrected ordinary least squares regressions, random effects panel and seemingly unrelated regressions) and corroborate to a considerable degree those obtained for Spanish regions in previous works.

The main conclusions are:

- 1. The border effect exists: the dummy variable quantifying it is always positive and statistically different to zero at the 1% significance level in all the regressions carried out in this work.
- 2. The border effect tends to decrease over time from 2000 to 2010, both considering its average value for all the regions in this period, and when analysing each Autonomous Community separately (it grows clearly only for Castile and Leon in this decade). This is a very important result, given that it indicates that home bias, the dependence of Spanish regions on the rest of the state, gradually decreases. In other words, the difference between interior and international flows is gradually decreasing. In this context, the Spanish foreign sector has been one of the most dynamic elements, or perhaps the most dynamic, since the start of the crisis.
- 3. Estimating all the regions together, the border effect is at a factor of around 10.5; the European Unión effect around a factor of 1.5 to 2, and the Coast effect can be quantified by a factor of 1.36 (i.e., an increase in flows with coastal countries compared to inland countries of 36%).
- 4. Estimating a panel independently for each Autonomous Community, the greatest border effect is produced in the island regions: the Canary Islands (factor de 58.36), and quite a lot lower, the Balearic Islands (factor de 29.81); possibly, their unique condition as islands makes them more dependent than other areas on transactions with the rest of the regions of Spain. In contrast, the Communities with the lowest border effect are those with the two largest, most diversified and dynamic cities in the country, Barcelona (factor de 8.11) and Madrid (factor de 5.17); their more cosmopolitan and heterogeneous nature means that the companies based there depend more on the exterior for their intermediate products, and at the same time, have a higher capacity and propensity for exporting.
- 5. If we distinguish between Autonomous Communities' imports and exports, the border effect is significantly higher for imports (factor of nearly 17) than for exports (factor of nearly 10). In other words, dependence on national flows for all our regions is stronger in their respective purchases. Drilling down to the level of each region estimated independently, this result is maintained in twelve of them.

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